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Natural OUTLOOK
PD-020/12-09 SEPTEMBER/OCTOBER 2012

PROTECTING TEXANS FROM TOXICS

Developing and deploying state-of-the-art techniques

On a cool, sunny day in April, 2006, three trailers sit alongside Interstate 35, between Georgetown and Temple, almost hidden from view of passing motorists. The almost inconspicuous cluster could easily pass as just another site along the road, of little consequence, but on this particular day their presence is essential—they are collecting air samples to assess the potential impact of the chemicals they find.

There are many chemicals in the environment, both man-made and naturally occurring. Chemical risk assessments—such as the year-long toxicological study conducted along IH 35 and two other highways—evaluate the impact those chemicals could have on human health, focusing especially on the type and severity of health problems a chemical might cause. In this case, the samples collected were used to determine whether or not concentrations of ultrafine particles, carbon monoxide, oxides of nitrogen, volatile organic compounds, and several particle-bound organics and carbonyl species decreased with distance from the road, or differed depending on the type of roadway.

The Toxicology Division

The Texas Commission on Environmental Quality relies on its Toxicology Division to help it make scientifically sound decisions when developing environmental regulation and policy. On any given day, the division's 13 staff members might assess whether the chemical emissions proposed in an air permit would be safe; evaluate whether the chemicals detected in the ambient air of a certain location might cause adverse health effects or a nuisance; determine whether the chemical contamination of a given industrial or residential site could cause adverse health effects; or help the Remediation Division decide whether a site needs to be cleaned up, based on risk to human health.

Determining how any chemical reacts in a human body is a complex, case-by-case enterprise. What could potentially harm a child may or may not necessarily affect a 300-pound man. There is a tremendous variation in how a human being will absorb, metabolize, or excrete any harmful compound, and the differences are never cut-and-dried. To further complicate matters, factors such as genetic makeup, lifestyle, and even an individual's residence all play a part in how any chemical travels through a human body.

"Over the past 20 years, toxicology has changed immensely," said Dr. Michael Honeycutt, director of the TCEQ Toxicology Division. "Techniques for evaluating the harmful effects of a chemical are much more advanced, particularly when it comes to the way chemicals affect human cells. We also understand more about the human body and how it responds to chemical exposure. Now, we need to rethink the way we conduct risk assessments to better incorporate all this new knowledge, to help our risk assessments to be more realistic and predictive."

New Challenges

As the population of Texas grows, and as more businesses set up in the state, the Toxicology Division finds itself focusing

on how both can interact, without business being detrimental to human health. This is the case with the expansion of natural-gas drilling in the state. The agency has taken the lead, conducting air quality studies in Houston, Midlothian, the Dallas–Fort Worth area, Corpus Christi, and the Barnett Shale area. In spite of the increased presence of well activity, studies have shown only slight increases in levels of air pollution and no indication of adverse health effects.

"The TCEQ has put enormous resources into the Barnett Shale that have been unparalleled by any other state. Our efforts have paid off. We've learned that oil and gas drilling can take place safely in urban areas," said Dr. Honeycutt.

National Recognition

The work that the division is doing is receiving national recognition. Two TCEQ toxicology studies—one on the risk to human health posed by nickel and 1,3-butadiene, and another on the risk posed by arsenic—were recently published in the journal *Regulatory Toxicology and Pharmacology*.

In May of this year, the TCEQ hosted the fourth workshop in a series organized by the Alliance for Risk Assessment. The series, "Beyond Science and Decisions: From Problem Formulation to Dose-Response Assessment," is designed to improve the risk-assessment process by developing "a compendium of practical, problem-driven approaches." Toxicologists from across the United States and Canada attended the workshop, both in person and via webcast.

"The meeting allowed the attendees to discuss a number of case studies designed to highlight biological and statistical issues related to dose-response assessment, which is the process used to determine the level at which a chemical will produce harmful health effects," said Dr. Honeycutt.

"The TCEQ presented a case study that showed that the way a chemical acts within the human body can be used to predict the level of that chemical in air at which health effects would be expected. Knowing these effect levels, we can better illustrate to other TCEQ staff, to risk managers, and to the public at large, the interval between the level that is safe and the level that is unsafe—for example, when communicating air-monitoring results from a specific project or statewide."

Creating New Assessment Guidelines

The agency has also taken the lead in formulating scientifically sound, state-of-the-art guidelines for developing toxicity factors.

"Naturally, we want to utilize the best methods to identify risk, but we also must be confident that new methods are, in reality, predictive and useful," Dr. Honeycutt said. "TCEQ Toxicology staff members are leaders in this process. In this way, we are playing a critical role in the changes being administered within the risk-assessment community. Doing risk assessment right is imperative in helping us decide where to place our limited resources. For example, water quality and quantity are much more of a risk for Texas than air quality."

General Approach to Toxicity Assessment

Search the Scientific Literature
Is a chemical toxic?
How is it toxic?
What is the relationship between exposure and toxicity?
Is there a dose observed that does not cause toxicity?

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Calculate the Duration Adjustment
What exposure duration is the toxicity factor going to protect?
What is the exposure duration in available studies?

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Calculate the Human Equivalent Dose
Was the study conducted in animals?
If so, what is the conversion to human equivalent dose?

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Apply Uncertainty Factors
What uncertainties exist about the given chemical?
Is the chemical's toxicity well-characterized?
Where studies conducted in animals or humans?

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Determine the Reference Value (ReV)
What is a safe dose or concentration?

Terms to Know

Adverse Effect	damage to normal functions of the body, which can include a wide array of problems, ranging from irritation to lung disease to cancer
ESL	(effects screening level) the toxicity factor used to evaluate the concentration of chemicals in emissions from applicant facility
AMCV	(air monitoring comparison value) the toxicity factor used to evaluate concentration of chemicals observed in air monitoring data
NOAEL	dose to which exposure does not cause an adverse effect
LOAEL	the lowest dose to which exposure causes an adverse effect

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